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COMPLETE SPECIFICATION

APPLICANT/ : *D.I. SYSTEMS CC*
UNIT 7, GREYSTONES PARK
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TITLE : *AN INTELLIGENT IMAGING DETECTION SYSTEM*

NO OF WORDS : *4573*

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Form P 1

REPUBLIC OF SOUTH AFRICA
PATENT ACT, 1978
APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPTS
[Section 30 (1)-Regulation 22]

Revenue stamps or revenue franking machine impression Official date stamp

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate.

Official application No.	(i) Applicant's or agent's reference
21 01 961673	

(ii) 71 Full Name(s) of applicant(s)

D.I. SYSTEMS CC

(iii) Address(es) of applicant(s)

UNIT 7, GREYSTONES PARK
GLEN ANIL, 4051

(iv) 54 Title of invention

AN INTELLEGENT IMAGING DETECTION SYSTEM

(v) [X] The applicant claims priority as set out on the accompanying form P2. The earliest priority claimed is (Country), (Number), (Date) ZA 94/9592 02/12/94

(vi) [ ] This application is for a patent of addition to Patent Application No. 21 01

(vii) [ ] This application is a fresh application in terms of section 37 and based on Application No. 21 01

(viii) This application is accompanied by:

X	1.	~~A single copy of a provisional or~~ two copies of a complete specification of .....pages.
X	2.	Drawings of .....2..... sheets.
	3.	Publication particulars and abstract (form P 8 in duplicate).
	4.	A copy of figure ..... of the drawings (if any) for the abstract.
	5.	An assignment of invention.
	6.	Certified priority document(s) (state number).
	7.	Translation of the priority document(s).
	8.	An assignment of priority rights.
X	9.	A copy of the form P 2 and the specification of S.A. Patent Application No. 21 01 94/9592
	10.	A declaration and power of attorney on form P 3.
	11.	Request for ante-dating on form P 4.
	12.	Request for classification on form P 9.
X	13.	Form P2 + copy

Incorporated within WEBBER WENTZEL

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Dated this 1ST day of MARCH 19 96

A. J. S. DUNLOP
Signature of applicant(s) or agent

Received Official date stamp 1996 -03- 01

This duplicate will be returned to the applicant's address for service as proof of

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FORM P.7
To be lodged in duplicate

REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978

COMPLETE SPECIFICATION

(Section 30(1) - Regulation 28)

OFFICIAL APPLICATION NO		LODGING DATE	
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INTERNATIONAL CLASSIFICATION	
51	

FULL NAMES(S) OF APPLICANT(S)

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TITLE OF INVENTION

54	AN INTELLEGENT IMAGING DETECTOR SYSTEM

This invention lies in the field of detection systems, for example a detection system for the detection of forest fires.

This specification will described detection of forest fires as an example.

Forest fires, often caused by natural phenomena, or by human negligence, result in great economic loss, the loss of human and animal lives, and a detrimental cost to the eco-structure. Often, fire fighters reach the scene of the fire when the damage has already been done, due to the fact that they are not always promptly notified of such fires. The result is that vast hectares of land are burnt, which often require costly clearing up operations and replanting. The current method of detecting forest fires results in foresting companies having to spend extra time and money employing more sophisticated fire fighting equipment to extinguish the rapidly spreading fire, with consequent increased risk to fire fighting personnel.

Many detection systems have been brought to the fore, for example smoke detection sensors coupled to alarm systems. However, the inevitability of false alarms casts a doubt upon the accuracy and undermines the practical utility of such systems. The other disadvantage with these systems is that they are largely dependent upon constant operator surveillance and a rapid response by him in order to achieve the main aim of fire detection.

Recent developments have lead to fire detection systems which employ thermal cameras, coupled to a processing and controlling system, which continuously monitors the forest and

alerts personnel of the presence of a forest fire. However, the major disadvantage with this type of system is the substantial cost of the thermal cameras which results in high costs for initially setting up the system. A cost of more than R 70,000-00 is not unusual for a thermal camera as at the date of writing this specification.

Therefore, a need exists for an improved fire detection system which reduces the extent of operator intervention while at the same time detects fires accurately with a reduced number of or preferably no false alarms. By the same token, a need exists for a detection system that provides an early detection of fire at a cost that is of benefit to the forestry industry.

Furthermore, there is also a need for more sophisticated motion detection systems.

It is therefore an object of the present invention to provide an intelligent detection system capable of intelligently detecting the presence of a fire, or the detection of any other form of motion relating to fire, through the use of modern computing power employing controlling and detection algorithms so as to overcome the disadvantages associated with detection systems of the prior art.

A further object of this invention is the provision of means for the detection of movement, specifically smoke and flame by day and glow by night together with other characteristic parameters or identifiers of the fire, for our example of a fire detection system, which employs a computer controlled programme conducting the operation of comparing the electronic images received by means, such as cameras, to a preprogrammed information residing in the memory means of the computer with the result that an alarm is triggered

and the operator alerted upon the detection of fire, as in our example, or any other related movement required to be detected.

In accordance with an aspect of the present invention, there is provided a method of automatically detecting motion which involves the steps of:

- storing preselected patterns in terms of characteristic identifiers of the type of motion required to be detected in memory means of a computer;
- capturing images in the form of image frames of the area in which the detection of motion is required;
- storing the image frames in memory by means of the computer;
- extracting characteristic identifiers of the motion required to be detected, from the image frames;
- storing the characteristic identifiers in memory means of the computer;
- updating the preselected pattern with the characteristic identifiers;
- storing a sensitivity value in memory by means of the computer;
- comparing the extracted characteristic identifiers with the preselected patterns;
- comparing the characteristic identifiers with the sensitivity value if the characteristic identifiers correspond with the preselected patterns;
- activating alerting means if the sensitivity value is exceeded.

In accordance with a preferred feature of the present invention, the motion required to be detected is fire, in particular, the fire is detected by detecting one or a combination selected from the following characteristic identifiers related to fires:

- smoke or flame is detected during day time conditions,
- change in light intensity is detected during night time conditions,
- the source of the light intensity

- the source of smoke or flame of the fire,
- the direction of motion of the center of gravity of the fire,
- the persistent nature of the fire,
- the terrain information pertaining to the area required to be detected, and
- the infra red radiation of the fire.

This information forms part of the said preselected patterns. The image frames captured are stored in the memory means of the computer, and together with the preselected patterns, are used to detect the fire.

Images from the plurality of cameras are captured or digitised frame by frame. This process is also commonly known as "frame grabbing". A graphics programme then enhances the quality of the image. The characteristic identifiers are extracted from the image frame, and the preselected patterns is updated or further developed preferably via a neural network, as explained below, wherafter the extracted preselected patterns is compared to the stored preselected patterns for the detection of a fire. The detection is carried out by an intelligent imaging process which involves the subtraction of the present captured image from the past stored image, thereby detecting any changes or motion in the monitored area. Naturally, image frames with similar information need to be compared, in other words, like image frames must be compared. In order to achieve this, under the influence of the computer programme, a shift in the stored image frames is carried out until the relevant image frame is found, and this past image frame is then compared to the presently captured image frame for the detection of the required motion. The retrieval of the specific required image may be carried out by using known electronic stabilisation techniques.

Once it has been established that the required motion has been identified, the motion is indicated on suitable display means by means of a graphic display. This display may vary according to a preselected alarm level. Unwanted moving objects, for example, moving vehicles, or trees swaying in the wind will not hinder the imaging process due to the comparison of the preselected patterns, and in particular the characteristic identifiers which define the specified motion. The sensitivity of the sector may be preselected by the controller.

It has been mentioned above that the preselected patterns is updated preferably via a neural network. A neural network is akin to the human brain, in that it contains a plurality of branch nodes inter linked by branch paths through which information is passed and the end result is that the network allows a computer to "learn" i.e. by building a pattern or a series of patterns which could also be referred to as a database, such that in future, the computer independently bases its decision making process upon the information it has learnt in the past.

Once the fire is detected, it is once again compared to a sensitivity or a reference "value", which may either be in a form of a look up table or a preselected patterns with predetermined information, and if this value is exceeded the computer alerts an operator, for example, by means of an alarm, or a voice interface module which audibly provides specific information, such as the location, status, direction of the fire. A preferable feature which can be incorporated within the computer, by way of a computer programme, is the ability of the programme to indicate the most optimum access routes in order to avoid the fire or to fight the fire.

In accordance with a second aspect of the present invention, there is provided an automatic intelligent motion detection system comprising at least one observation post accommodating a video camera, the video camera capturing images which are transmitted by suitable telecommunication means to a control station, the control station accommodating at least one computer which captures the images originating from the video camera in real time, the computer digitising the image frames and storing this information in its memory means, the memory means further storing a preselected patterns related to characteristic identifiers of the type of motion required to be detected, and this preselected patterns being compared to characteristic identifiers extracted from the image frame for the detection of the particular type of motion, under the influence of a computer program also residing in the computer's memory means, the display and detection of motion being displayed on a suitable monitor connected to the computer.

In accordance with a preferred feature of the present invention, a plurality of observation posts are suitably positioned around the control station. This arrangement allows for a wider area to be monitored.

Preferably, the video camera is housed in a protective encasement, thereby enhancing its durability and extending its life span.

The cameras are accommodated on the observation post such that they may be either manually or automatically rotated. The cameras may be continuously rotated through an angle, for example, of 335° back to back in the horizontal plane covering, for example, a

360° field of view, or alternatively, the camera may be rotated at predetermined time periods only. The camera may also be panned, tilted and zoomed. The above controlling of the camera may be conducted manually from the control room via a device adapted for such purpose, with the control signals being transmitted via the telecommunication means. Alternatively, the controlling of the camera may be carried out automatically using the said telecommunication means and under the influence of the computer programme.

The said telecommunication means could comprise either one or a combination, selected from a radio channel (i.e. microwave channel), a satellite channel, fibre optic cable or electrical conductor.

In accordance with a further preferred feature of the present invention, the camera is solar powered or wind powered, or both. Accordingly, during day light, solar rays source the camera, while wind generators source the camera during low light intensity and night time conditions. Preferably, the camera is also battery backed, thus ensuring continuous operation in the event of the solar power means or wind power means malfunctioning.

The control centre is preferably provided with an uniterruptable power supply (UPS) to ensure reliable operation even in the event of a power failure.

In use, the video camera captures the images in a form of a series of image frames, the capturing occurring under the influence of the computer programme. Preferably, the captured image frames may be enhanced to facilitate motion detection, the enhancing function being carried out under the influence of the computer programme. Typically, the

enhancing functions may include a noise reduction feature, the enhancement of the picture contrast, and other such similar enhancing features.

The images are captured and displayed on display means coupled to the computer. The past stored image frame is subtracted from the present captured image frame, thereby identifying the motion and displaying this by way of the graphics. By using the preselected patterns, the computer programme is able to detect whether the required motion has been identified. By comparing the extracted preselected patterns with the sensitivity "value", alerting means is activated if the this "value" is exceeded.

The computer monitor is preferably provided with touch screen control functions so as to facilitate the easy operation of the system and further to reduce the possibility of incorrect keys pressed in the case where a keyboard is used, for example. This feature also allows a relatively unskilled operator to operate the detection system.

The camera specified may have an infra red facility for use at night.

The invention will be more fully described by way of example with reference to the accompanying drawings in which:

Figure 1 is a schematic representation of the manner in which the detection system is configured, and

Figure 2 is a schematic representation of individual components of the motion detection

system and the configuration thereof.

The detection system of the present invention comprises at least one, but preferably a plurality of observation posts or towers for a wider field coverage. Figure 1 shows four towers 1 to 4 strategically positioned around a central tower 5 which, for convenience, will be referred to as a receiving tower, however, it is used for both receiving and transmitting information.

The towers are equipped with cameras 6 to 9, and each camera is encased in a protective housing. The camera is provided with means, such as a motor with suitable mountings accommodating the camera body, which means allow it to be rotated continuously or manually, from the control centre, through, for example an angle of 335° in the horizontal plane covering a 360° field of view. The means may also allow the camera to be rotated stepwise or through a predetermined range, for example. The means also allows the camera to be tilted in the vertical plane. This may be carried out by gearing, for example.

Signals from the cameras are transmitted to receiver tower 5 through telecommunication channels 10 to 13. The channel could comprise a microwave link, for example. The signals are then transmitted to control centre 14 via conductor 15, which could be a fibre optic cable. A conductor is preferred for this link since the distance between the receiver tower and the control centre would be small, thereby making such a link feasible, and further, a fibre optic cable reduces the possibility of noise interference as is the case in telecommunication channels.

Figure 2 shows in greater detail the components of the system at the observation post and the control station. At the tower, the camera is coupled to a PTZ unit 17 which allows for the panning, tilting and zooming of the camera. This unit is controlled by a PTZ controller 18 which receives control signals from the computer 29 at the control station via a telemetry channel comprising antenna 19. Images captured by the camera are transmitted to the microwave transmitter 20 which relays this information to the control station via microwave dish antenna 21. The aforementioned units are powered via the power management unit 22 which sources and manages the power from solar panels 23 and wind generator 24. Accordingly, energy is provided by solar radiation through the solar panels during conditions of adequate solar radiation intensity. While the wind generator sources the units during low solar radiation intensity, for example during night time conditions or overcast conditions. In the event of failure of the solar or wind generator units, the units are powered by backup batteries 25.

At the control centre, the captured images are received in microwave signal form by microwave dish antenna 26. The signals are demodulated and filtered by converter unit 27. The converter unit may also carry out other functions such as enhancing the signal to noise ratio, for example. The signals are amplified by receiver amplifier 28. The signals are then fed into the computer 29. Under the influence of the computer programme residing in memory means of the computer, fire detection and alerting is carried out as described above.

Monitors 30 associated with each camera on each observation post are coupled to the computer and accordingly display the images captured by the respective cameras. A

telemetry channel is also coupled to the computer, which telemetry channel comprises an amplifier 31 to amplify control signals, and an antenna 32. Through this channel, control signals are transmitted to the PTZ controller 18 on the observation post, for controlling the panning, tilting and zooming functions of the camera.